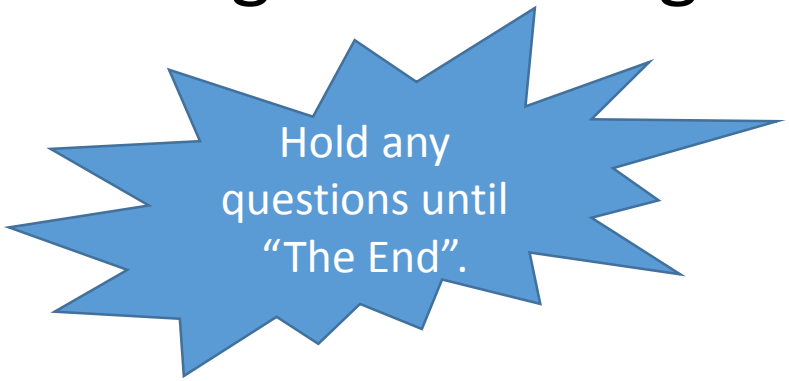
Bridges and Structures Consultant Training

May 10, 2018

Bridge Design Policy

Mike Nop

- Sampling of Some Recent BDM Changes
- Sampling of Some Upcoming BDM Changes (Maybe)
- Comments



All Aashto Lrfd references are with respect to the 8th edition, 2017.

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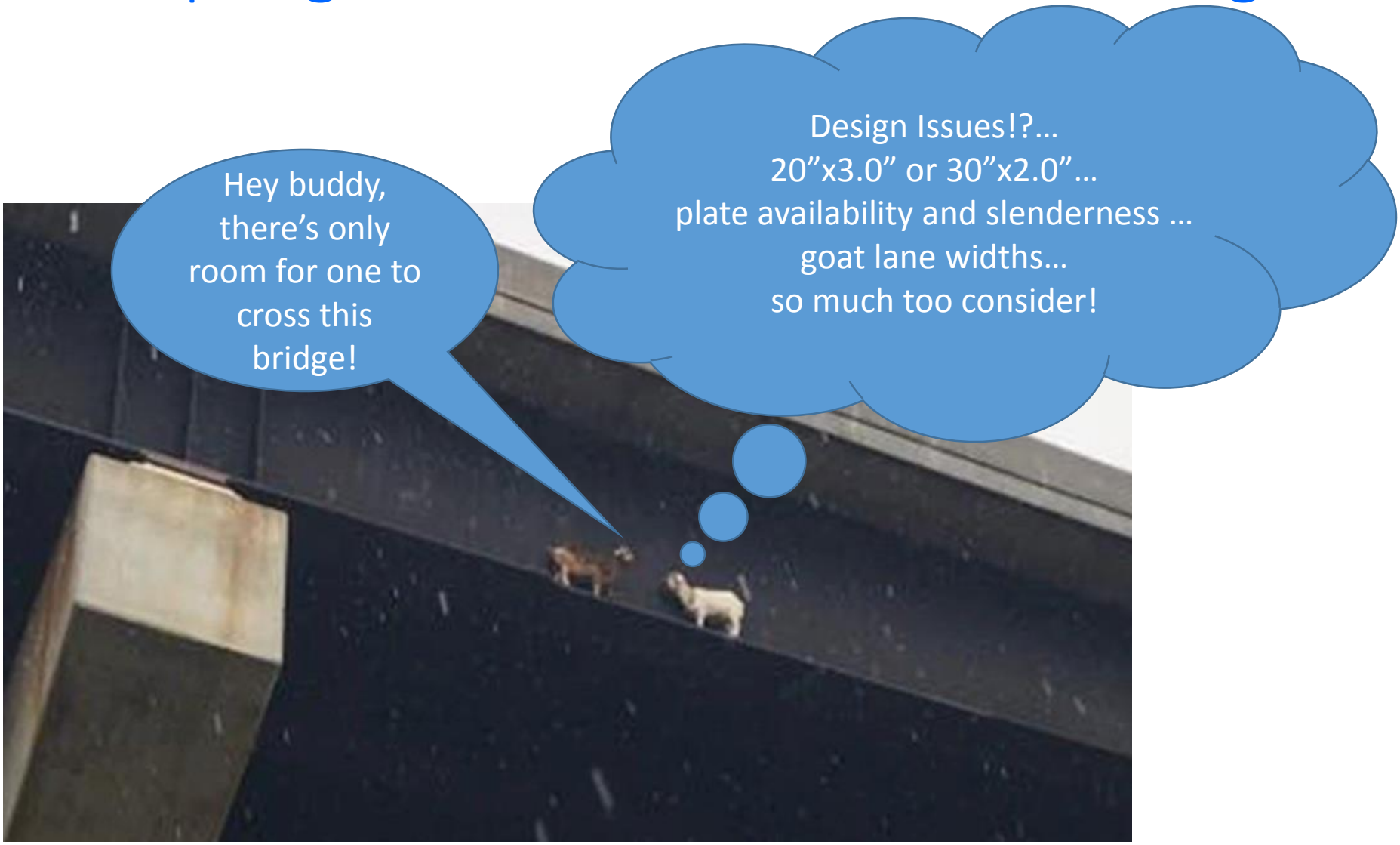
Sampling of Some Recent BDM Changes



http://www.foxnews.com/us/2018/04/06/pennsylvania-state-crews-rescue-goats-stranded-on-bridge-beam.html

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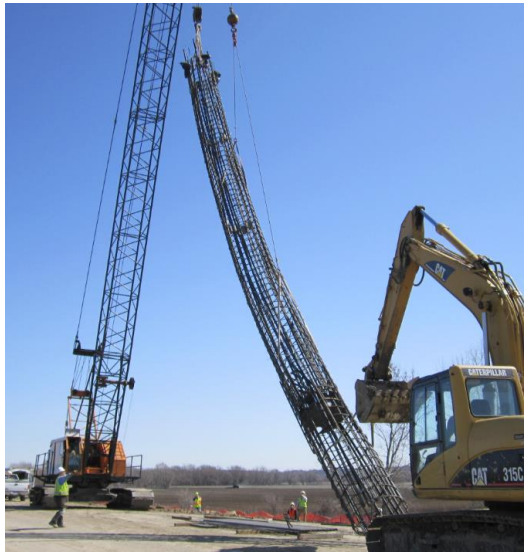
Drilled Shaft Rock Socket Depth

BDM 6.3.1.1, 6.3.4

The depth of the rock socket shall be the maximum of the following two conditions:

- The depth of the rock socket shall be at least 1.5 shaft diameters.
- In order to minimize the effect of construction issues, the depth of the rock socket shall extend an additional 12” into the rock beyond what is required for geotechnical capacity.

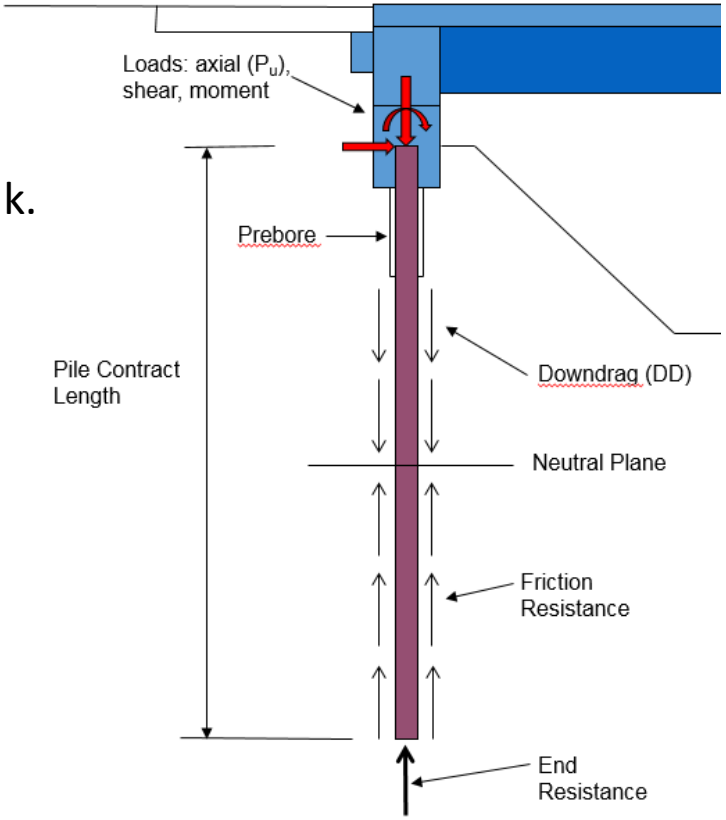


SRL-1.5 for Steel H-Pile Downdrag **BDM 6.2.2.2, 6.2.6.1**

When downdrag is present the SRL-1 nominal structural resistance may be increased by 25% essentially creating SRL-1.5 which is halfway between SRL-1 and SRL-2.

For example, the nominal structural resistance for a typical Grade 50 HP 10x57 pile in BDM Table 6.2.6.1-1 has an SRL-1 value of 243 k and an SRL-2 value of 365 k. The SRL-1.5 value would be 304 k.

The total factored axial compression load plus the factored downdrag load shall be less than or equal to the factored structural resistance of SRL-1.5.



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Pile Uplift Anchors BDM 6.2.6.1, C6.2.6.1

Steel Piles HP10 and Larger	Pile Anchorage Types		
	12” embedment	24” embedment	2-#8 V-shapes
Nominal Resistance	100 k	175 k	175 k

Strength and Extreme Event Limit State Resistance factors are 0.25 and 0.40, respectively. The preferred option is to resize the footing to eliminate uplift.

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Early Removal of Pier Cap Formwork **BDM 6.6.1.1, 6.6.4.1.1.1, 13.8.2 (Cadd Notes E735A and E735B)**

Early removal of pier cap formwork allows the contractor to reuse the same forms on multiple piers in a reduced time frame. As such, office policy requires designers to check if the pier cap formwork for typical frame and T-piers can be removed when the concrete strength of the pier cap reaches 2.50 ksi.

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Steel Girder Fit Condition
The deflected girder geometry in which the cross-frames or diaphragms are detailed to connect to the girders.
[Aashto Lrfd 6.2 and 6.7.2]

Common Fit Conditions

- No-Load Fit (NLF)
- Steel Dead Load Fit (SDLF)
- Total Dead Load Fit (TDLF)

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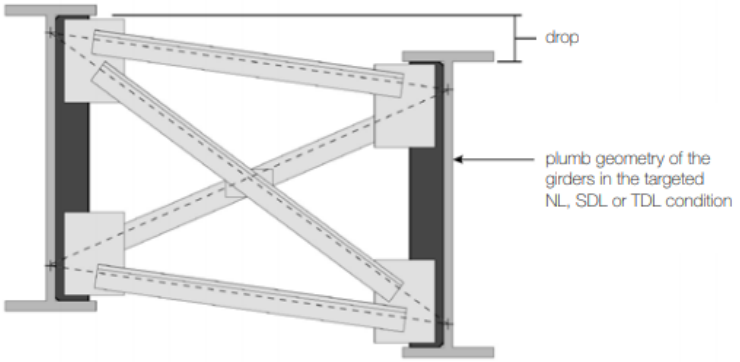
Table 1 **Common Fit Conditions**

Loading Condition Fit	Construction Stage Fit	Description	Practice
No-Load Fit (NLF)	Fully-Cambered Fit	The cross-frames are detailed to fit to the girders in their fabricated, plumb, fully-cambered position under zero dead load.	The fabricator (detailer) sets the drops using the no-load elevations of the girders (i.e., the fully cambered girder profiles).
Steel Dead Load Fit (SDLF)	Erected Fit	The cross-frames are detailed to fit to the girders in their ideally plumb as-deflected positions under the bridge steel dead load at the completion of the erection.	The fabricator (detailer) sets the drops using the girder vertical elevations at steel dead load, calculated as the fully cambered girder profiles minus the steel dead load deflections.
Total Dead Load Fit (TDLF)	Final Fit	The cross-frames are detailed to fit to the girders in their ideally plumb as-deflected positions under the bridge total dead load.	The fabricator (detailer) sets the drops using the girder vertical elevations at total dead load, which are equal to the fully cambered girder profiles minus the total dead load deflections.



Skewed and Curved Steel I-Girder Bridge Fit (NSBA, August 2016)
https://www.aisc.org/globalassets/nsba/technical-documents/skewed-curved-steel-bridges-august-2016-summary-final.pdf
https://www.aisc.org/globalassets/nsba/technical-documents/skewed-curved-steel-bridges-august-2016-final.pdf

BDM 13.9.2

E904: Steel bridge, intended erected position

THE GIRDERS ARE TO BE FABRICATED FOR A STEEL DEAD LOAD FIT CONDITION.

Note that horizontally curved girders with arc span lengths greater than 300’ and an L/R ratio greater than 0.1 shall be fabricated for a no-load fit condition.

[May need to update based on Aashto.]

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Steel Girder Erection Plan **BDM 5.5.2.4.4, 13.2.2 Cadd Note E70, 13.9.2 Cadd Note 905, Special Provision**

The contractor, in accordance with the Special Provision, shall provide a GEP submittal for review when one or more of the following conditions is applicable:

- Shoring towers and/or strong-backs are used by the contractor.
- Erection is from floating equipment.
- The girder system includes lateral bracing.
- Girder radius of curvature is less than 20 times the span length.
- The bridge is over or adjacent to a railroad.

Designers shall also consider including a Suggested Girder Erection Sequence (SGES) in the plans whenever a GEP submittal is required or when complex traffic control requirements are needed for a bridge site.

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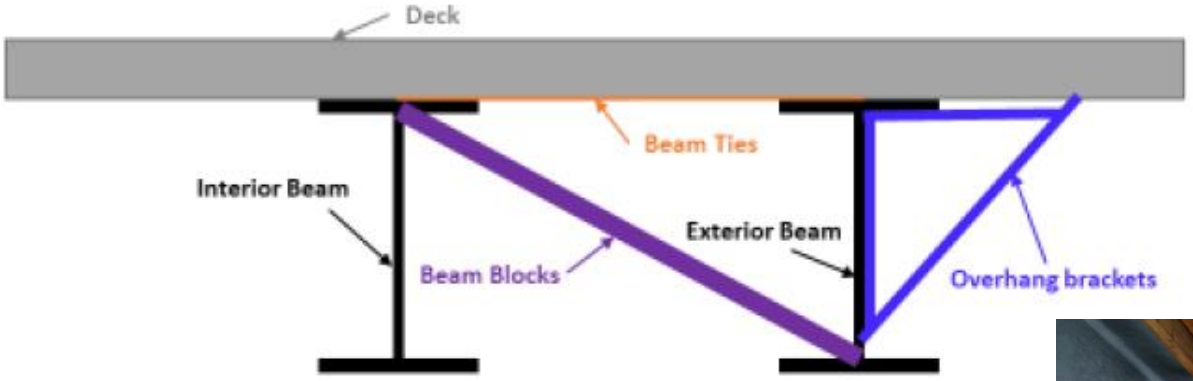
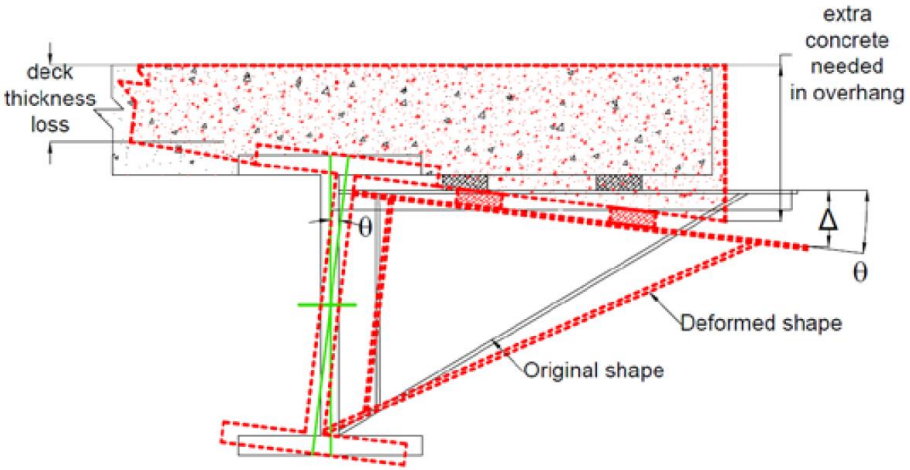
Temporary Bracing for Steel Beam Deck Pour **DM 5.5.2.2.6, 13.3.2 Cadd Note E204**

E204: Steel beams, temporary bracing

THE CONTRACTOR IS RESPONSIBLE TO PROVIDE SUFFICIENT TEMPORARY BRACING TO MINIMIZE LATERAL DEFLECTION AND ROTATION OF EXTERIOR STEEL BEAMS DURING DECK PLACEMENT. LATERAL DEFLECTION AND ROTATION OF EXTERIOR BEAMS MAY RESULT IN THIN DECKS AND AN UPWARDS SHIFT IN BAR MATS WHICH CAN DECREASE CONCRETE COVER…





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1/16” Sacrificial Thickness for Unpainted Weathering Steel

BDM 5.5.2.1.1, 5.5.2.1.5, 5.5.2.4.1.2, 5.5.2.4.1.3, 5.5.2.4.1.6, 5.5.2.4.1.10

Unpainted weathering steel girders, regardless of bridge location, shall have a minimum 1/16-inch sacrificial thickness added to the minimum design thickness for all web and flange plates, including bolted field splice plates for girders. Secondary members (e.g. stiffeners, cross frames, etc.) are not required to have an additional sacrificial thickness.

Figure 28. Fascia girder of I-235 eastbound on-ramp at 2nd Avenue. Note transition from Category 3 patina at mid-height of the web to Category 2 at the top of the bottom flange in areas subjected to direct salt spray from the I-235 mainline.

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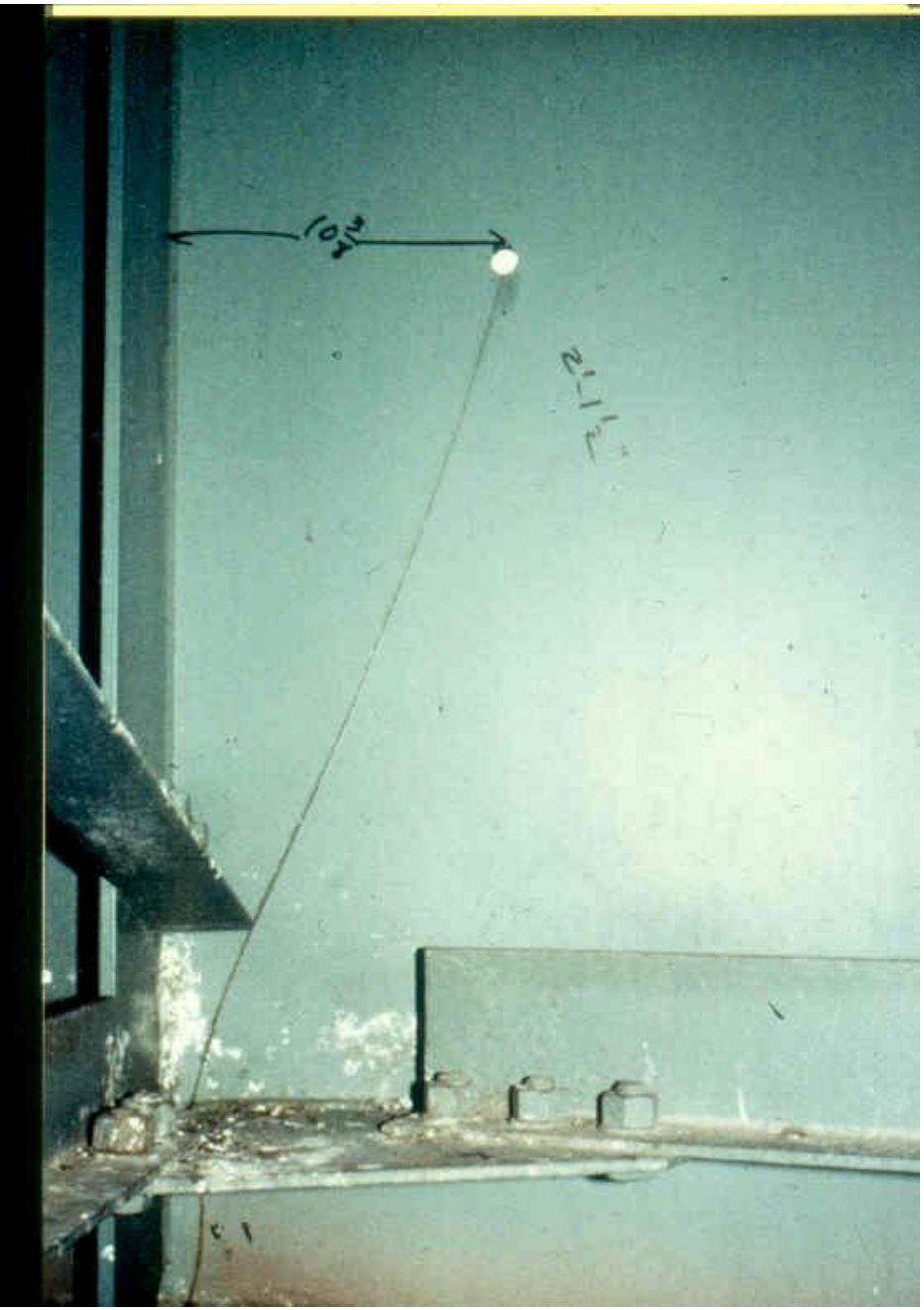

Steel Girder Fatigue

BDM 5.5.2.2.3, 5.5.2.4.1.15, 13.2.2 Cadd Note E50E

The cost of girders designed for finite fatigue life shall be compared to the cost of girders designed for infinite fatigue life. If the difference in cost is nominal, then base the final design on infinite fatigue life.

FATIGUE DESIGN BASED ON FATIGUE I LOAD COMBINATION AND INFINITE LIFE [or FATIGUE DESIGN BASED ON FATIGUE II LOAD COMBINATION AND 75 YEAR FINITE LIFE WITH SINGLE LANE ADTT (ADTTSL) OF ?.]

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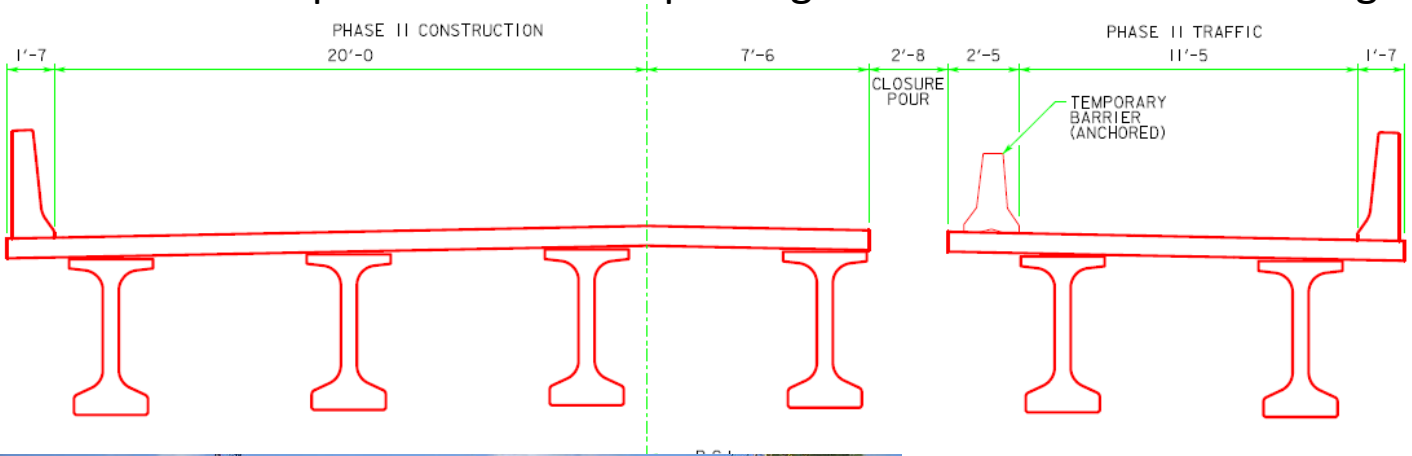
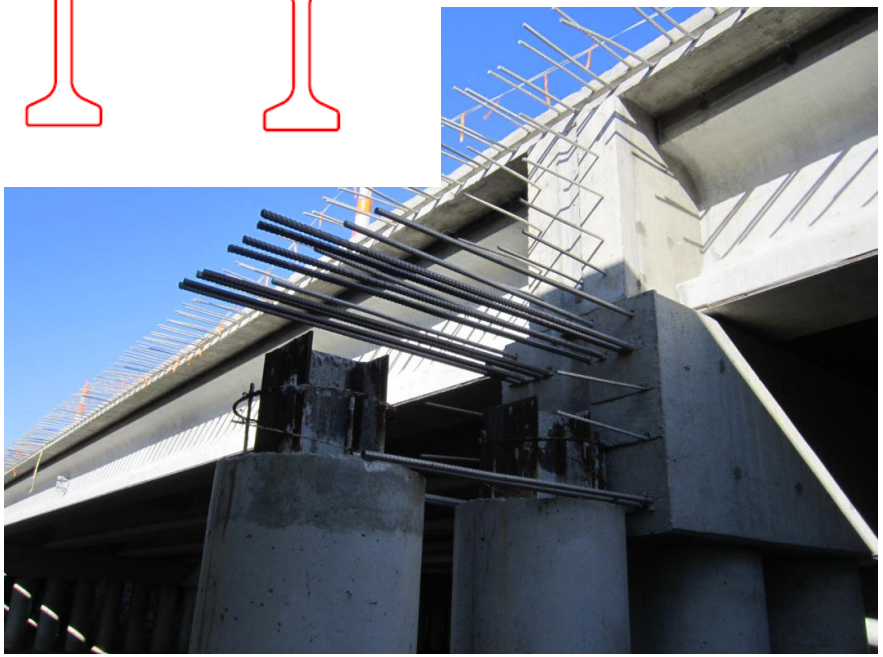
Recent BDM Change #10 - January 2017

Haunch for Staged Construction **BDM 5.2.4.1.2**

Consider tributary deck width when determining haunch thickness and beam line haunch elevations particularly for bridges involving staged construction and closure pours. Doing so should help reduce cross-slope irregularities and minimize deck grinding.





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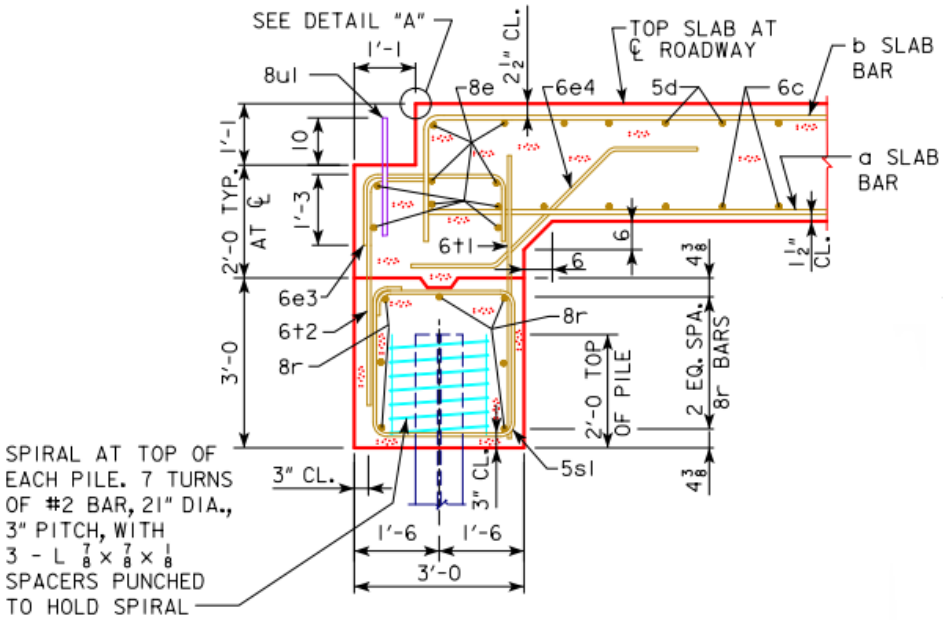
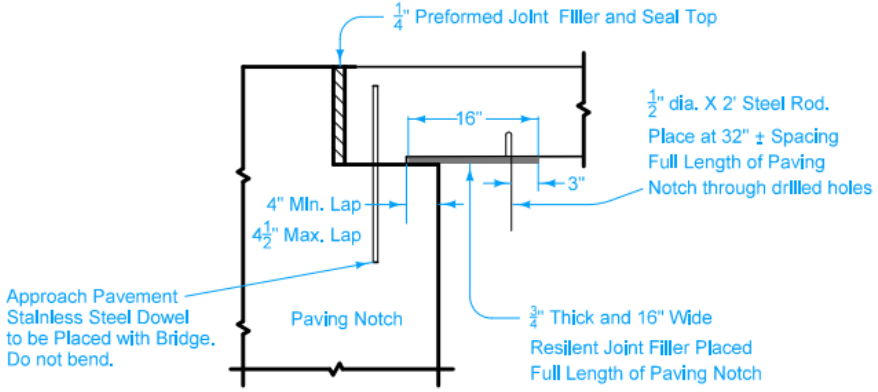
Tied Approaches for CCS Bridges

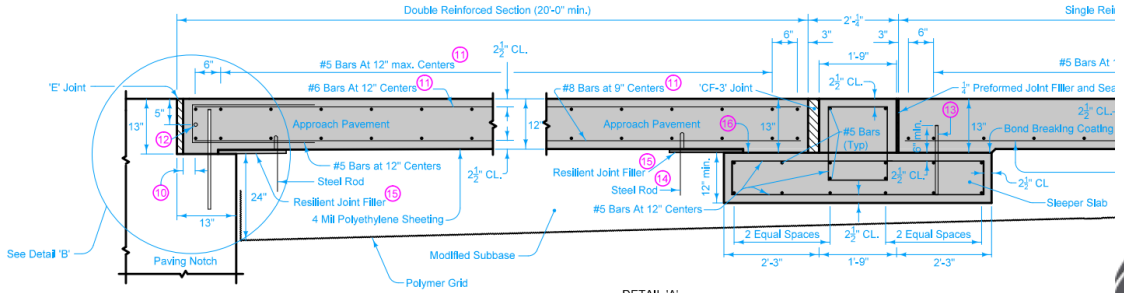
BDM 5.6.2.1.1, 5.6.2.4.2, 5.8.5.1.1, 6.5.1.1.1, 6.5.4.1.2, 6.5.4.2.2

Tied approaches shall be used for all CCS bridges on the interstate and primary system. The J40-14 and J40-14 standards were updated to include the stainless steel tie bars in connection with BR-205.





DETAIL 'B'



DETAIL 'A' (Slab Bridge)

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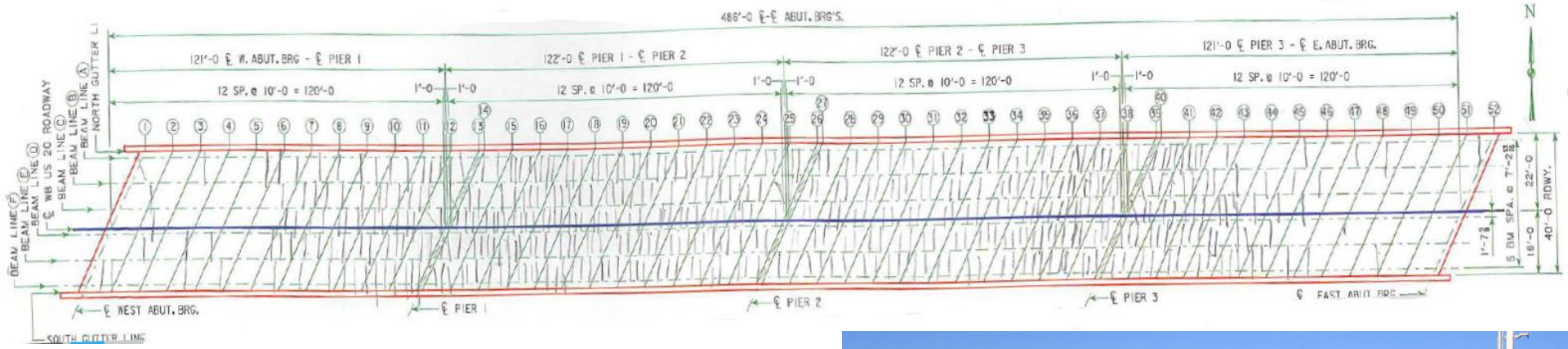
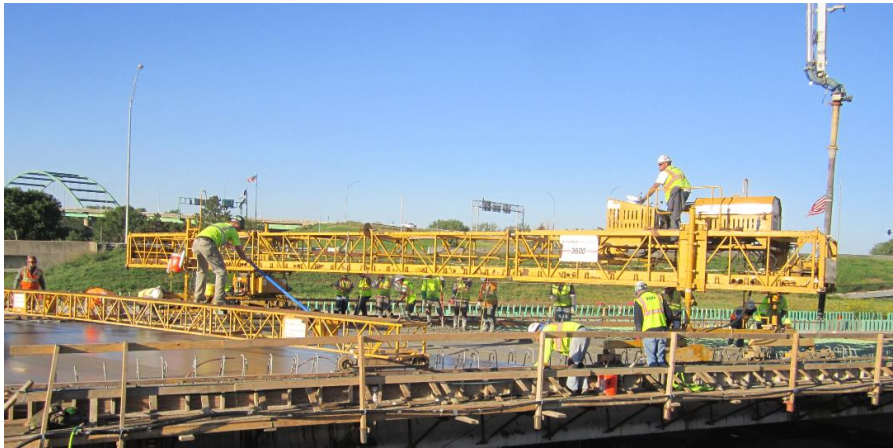
Recent BDM Change #12 - April 2018

Deck Pour Monitoring **BDM 13.2.2 Cadd Note E75**

RESEARCHERS FROM IOWA STATE UNIVERSITY WILL BE OBSERVING PLACEMENT OF DECK CONCRETE FOR THIS PROJECT. CONTRACTOR IS REQUIRED TO CONTACT BRENT PHARES AT (515)294-5879 THREE (3) DAYS PRIOR TO DECK CONCRETE PLACEMENT…

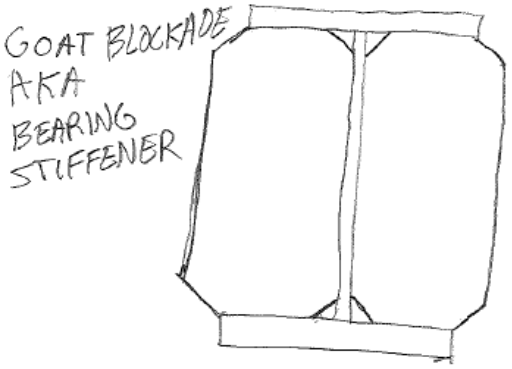
Place the following note on all bridge plans with deck/slab pours (PPCB, Steel Beam, and CCS bridges) with the following letting dates: July 17, 2018 letting through April 16, 2019 letting (turn-in dates of May 1, 2018 through February 5, 2019).





Sampling of Some Upcoming BDM Changes (Maybe)

BDM Solutions!!!!



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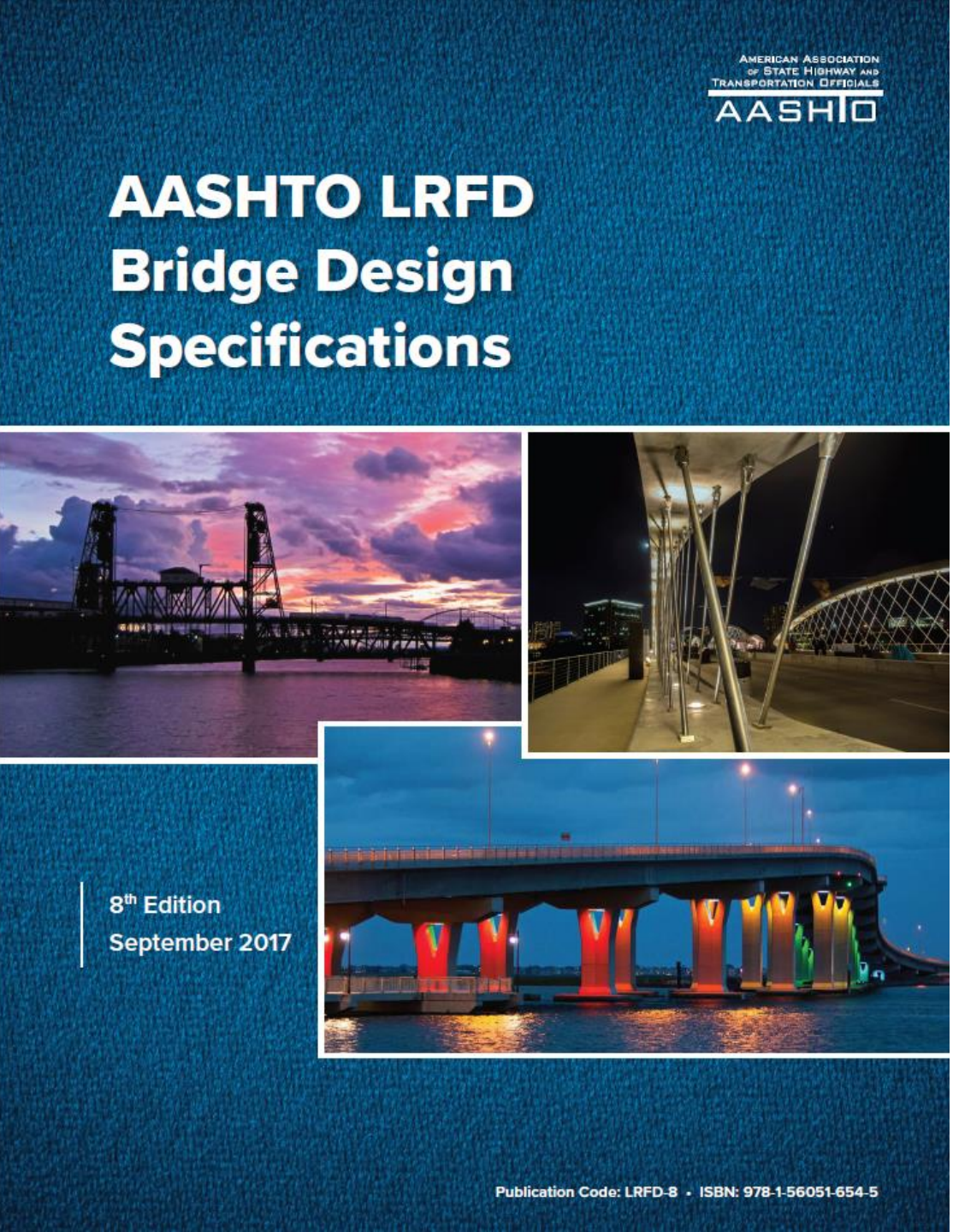

Upcoming BDM Change #1

AASHTO LRFD 8th Edition, 2017
Adopted for all designs started on October 1, 2018.

The standards will be updated to the 2017, 8th edition by OBS as time permits. The standards should be used “as is” until they are updated by OBS.

Stuart Nielsen will address one of the more significant changes.

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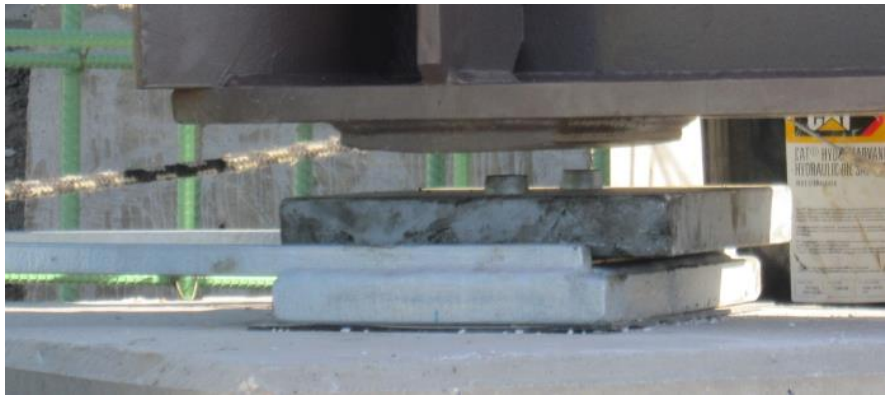
Upcoming BDM Change #2

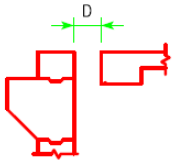
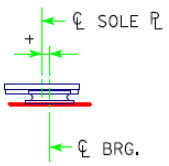
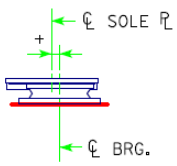
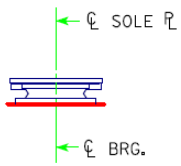
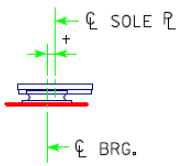
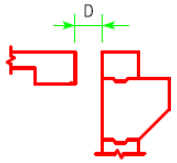
Expansion Bearings

Use design setting factor for elastomeric and bronze sliding plates.



Use temperature setting table for rockers, disc, and pot bearings. Plan note shall require jacking and setting of bearings after all steel girder erection, but prior to opening bridge to live load. (PPCB bridges don't commonly use these bearings.)

BEARING AND EXPANSION DEVICE SETTING (INCHES)

TEMPERATURE AT TIME OF SETTING *	WEST ABUTMENT	WEST ABUTMENT	PIER NO. 1	PIER NO. 2	EAST ABUTMENT	EAST ABUTMENT
						
10°F	$1'-2\frac{7}{16}$	$-1\frac{7}{16}$	$-\frac{15}{16}$	0	$-\frac{13}{16}$	$1'-1\frac{13}{16}$
50°F	$1'-1$	0	0	0	0	$1'-1$
90°F	$1\frac{9}{16}$	$1\frac{7}{16}$	$\frac{15}{16}$	0	$\frac{13}{16}$	$1'-0\frac{3}{16}$

Upcoming BDM Change #3

Painted Weathering Steel Bridges: Consideration shall be given to using painted weathering steel for grade separations with all of the following "tunnel-like" conditions:

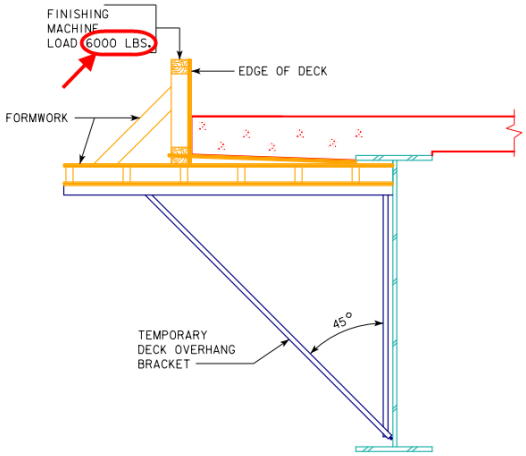
- Vertical clearance is 20 feet or less because these bridges are more susceptible to "tunnel-like" conditions
- Bridges over interstates in urban corridors since deicer treatments in these areas are typically more concentrated
- ADTT = 10% or more under the bridge since trucks generate more misting with deicers than cars do
- Posted speed limit is 55 mph or greater since higher speeds generate more misting with deicers

Figure 20. Category 1 patina on top of an interior girder bottom flange; note the large, loose, thick flakes that cover virtually the entire surface. Section loss is not yet apparent in this case.

Figure 27. Category 1 tape test sample.

Upcoming BDM Change #4

Deck Removal Projects: Check bridge capacity during deck removal based on typical construction loads so that the contractor does not need to make a submittal. For example, assume a 60 kip excavator with a 16 kip payload working from one end of the bridge to the other or two pieces of equipment working from the middle to the ends.



TEMPORARY DECK
OVERHANG BRACKET DETAIL

Upcoming BDM Change #5

Construction Loading:
Increase finishing machine load to 9 kips on one side.

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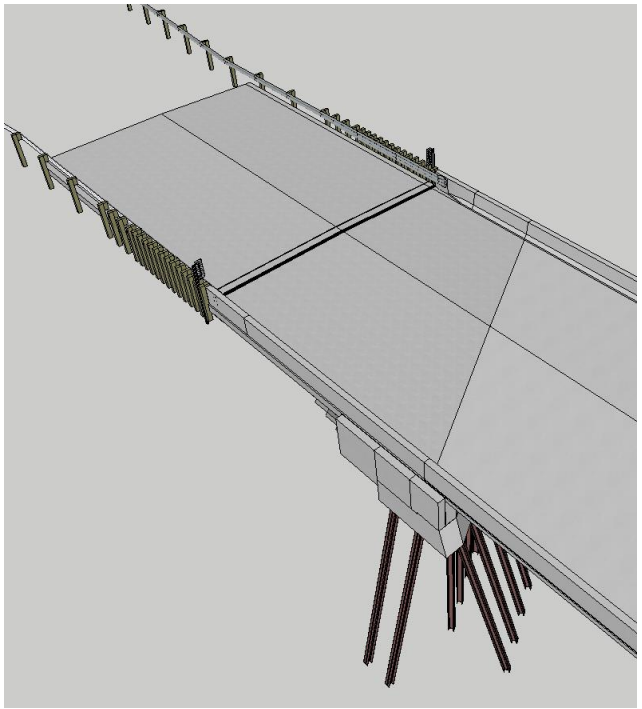
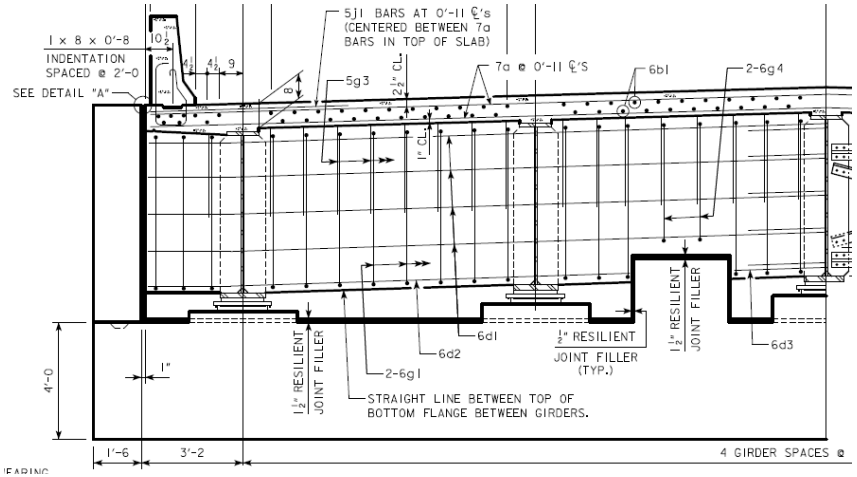
Upcoming BDM Change #6

Semi-integral Abutments: Potential applications for semi-integral abutments on new structures include the following situations:

- shallow bedrock precludes use of steel piling for integral abutments,
- drilled shaft foundations are too stiff to be used with integral abutments,
- end span restrictions for steel girders with integral abutments cannot be met,
- wide bridges of 120 feet or more with lateral expansion, and
- bridge length and skew restrictions prevent use of integral abutments.





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Upcoming BDM Change #7


IOWA DOT

OFFICE OF BRIDGES AND STRUCTURES

Reviewed in accordance with current policy

☒ NO EXCEPTIONS TAKEN

☐ MAKE CORRECTIONS (NO RESUBMITTAL NEC.)

☐ REVISE AND RESUBMIT

March 17, 2017

This review is for strength and arrangement of component parts. Any deviation from the plans or specifications not clearly noted by the Contractor has not been reviewed. Review by the Engineer shall not serve to relieve the Contractor of the contractual responsibility or any error or deviation from the contract requirements.

Shop Drawing Stamp **BDM 5.5.2.4.3**

We've noticed not everyone likes the language in our shop drawing stamp since some firms have developed their own, probably in consultation with their legal department. Our desire is to have everyone use one stamp, so we would like you to send in your stamp language such that we can select the best wording.

IOWA DOT

Follow-up

- BDM policies
  - Report errors, omissions and unclear policies
  - Suggest changes and improvements
  - Feel free to contact us (me)
- Implementation of 6 month BDM changes
- OBS design applications on the website
- OBS training - at the DOT, webinars, videos

The End -- Questions?

Thank you for participating in the Goat Relocation Program!

http://www.foxnews.com/us/2018/04/06/pennsylvania-state-crews-rescue-goats-stranded-on-bridge-beam.html

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